

MONTHLY PROGRESS REPORT

Slurry/Micro-Surface Mix Design Procedure

August 2004

To: T. Joe Holland, CALTRANS
Contract No.: CALTRANS 65A0151
Contractor: Fugro Consultants LP
Contract Period: June 30, 2003 – Nov. 30, 2007
Prepared By: Jim Moulthrop, Principal Investigator
Date Prepared: September 13, 2004

PROJECT OVERVIEW

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines, and specifications.

Phase I of the project has two major components: 1) the first consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems, 2) the second deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods, evaluate successful constructability indicators, conduct ruggedness tests on recommended equipment and procedures, and prepare a report that summarizes all the activities undertaken under the task.

In Phase III, the project team will develop guidelines and specifications, a training program, and provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a Final Report.

|| NOTE: New information for the current month is notated by double-lines to the left of text, tables, or figures.

PHASE I—LITERATURE SEARCH AND WORK PLAN DEVELOPMENT

Task 1—Literature Review and Industry Survey

Task 1.1 Literature Review

Completed. The literature review process is completed with all sources of information on the design and use of micro-surfacing and slurry seals reviewed and summarized in Chapter 2 of the Phase I Report.

Planned. Although the literature review process is finalized, any new information will be reviewed as it becomes available.

Task 1.2 Industry, Agency, and Advisory Panel Surveys

Completed. Following discussion between team members and Caltrans, three surveys were designed:

- Agencies: Those using the AASHTO LISTSERVE link (United States and Canada).
- Contractors and Manufacturers: Those in the United States and the international slurry surfacing and micro-surfacing industry.
- Advisory Panel Contractors.

The three proposed survey questionnaires were included in the August 2003 monthly report and the results were summarized in the Phase I Report.

Task 2—Work Plans for Phases II and III

Completed. The Phase II Work Plan was included in Chapter 3 of the Phase I Report. The Phase III Work Plan was included in Chapter 4 of the Phase I Report. The final Phase I Report was submitted to CALTRANS in March 2004.

PHASE II—MIX DESIGN PROCEDURE DEVELOPMENT

Tasks 3 & 4—Evaluation of Potential Test Methods & Successful Constructability Indicators

The team is working towards the acquisition of the new test equipment to be used in Phase II. The equipment includes:

- Visco-Time®: an apparatus that will measure the rotational viscosity of a slurry system with time. The results will be used to evaluate the time available for mixing and spreading the mixture in the field and an estimate of the set time. Two similar devices are available from Europe: Viscoclick and Eurostar. The difference between the two devices is in the method of measuring the rotational torque: Viscoclick measures the torque acting on the mixing shaft while Eurostar measures the torque acting on the motor that rotates the mixing shaft. Viscoclick is potentially more accurate, but also more expensive. A preliminary evaluation and comparison of the two devices will be carried out by the team next month. The study will allow for the selection of the device best suited for the project.

The Consolidated Engineering Laboratory management is reviewing the final contract arrangements for the acquisition of the equipment and the target date for the delivery of the devices is late September 2004.

- French Wet Track Abrasion Test (FWTAT) Device: An apparatus that is very similar to the Wet Track Abrasion Test (WTAT), but uses a set of wheels instead of the rubber

hose normally used for the abrasion head. The apparatus has been modified to use the French Wheel fixture and is going through refinements.

This equipment has been manufactured, is in the laboratory at Consolidated Engineering Laboratories, and is ready to begin testing. Several trials on "dummy" specimens have been done to assure that the equipment is in working order.

- Modified Cohesion Tester: An automated modified cohesion tester (i.e., the torque will be applied by means of an automated device instead of a manual method). The team is in the process of modifying the device to make it automated.

We anticipate the modifications to be complete and the device ready for testing by the end of September 2004.

- Environmental Chamber: Many of the tests of Phase II will be performed under controlled temperature and humidity conditions that require the use of one or several environmental chambers. These are already available in the CEL laboratories where most of the testing will be performed.

The matrix of tests to be performed in Task 3 is being reviewed by the team; a range of conditions will be used in the test program:

- Humidity: high and low
- Temperature: 10, 25 and 30°C (50, 77 and 86°F)
- Cure time: 30, 60, 90 minutes; 12 and 24 hours
- Soak time: 1 hour; 1, 3, 6 and 9 days

Tentatively, five mixes will be included in the test program of which four are made of aggregates and binders known to perform well in slurry systems and one will be made of materials for which the performance is unknown. The five mixes are:

- Mix 1 Ralumac + Table Mountain Aggregate (supplied by Koch)
- Mix 2 Ralumac + Lopke Gravel Aggregate (Koch formulation for emulsion)
- Mix 3 VSS PMCQS-1h + Table Mountain Aggregate
- Mix 4 Vestal PM CQS -1h + Lopke Gravel Aggregate
- Mix 5 Unknown

Testing of the Table Mountain Aggregate is complete. The Lopke Gravel Aggregate will be received and tested next month.

Tests have been completed for both aggregates. Tests included sieve analysis, sand equivalent, Los Angeles abrasion, and sodium sulfate soundness testing. The results were noted in Attachment A of the July 2004 progress report. The aggregates have been forwarded to Valley Slurry Seal and Koch Materials for the formulation of the emulsions.

The sodium sulfate testing had been re-done because an old solution was used for the initial testing and there is some concern that the results might not be valid. The results are included in Attachment A of the August 2004 (current) progress report.

Task 5—Ruggedness Tests of Recommended Equipment and Procedures

In comparison with the testing in Tasks 3 and 4, the tests of Task 5 will be performed at a single set of temperature, humidity, and cure time conditions. “Standard” conditions were chosen by the team: 50 percent humidity, 25°C temperature, etc. Slight variations in these parameters will be allowed to evaluate the ruggedness of the test procedures. The team is currently reviewing the test factorials proposed in the Phase II Work Plan.

Task 6—Phase II Report

No Activity

PHASE III— PILOT PROJECTS AND IMPLEMENTATION

Task 7—Development of Guidelines and Specifications

A list of references that contain guidelines and specifications has been drafted and is noted below:

- ISSA A105 Guidelines for Slurry—Available
- ISSA A143 Guidelines for Micro-Surfacing—Available
- TTI Report 1289-2F Use of Micro-Surfacing in Highway Pavements—Available.
Report contains:
 - Methods and Materials Specifications
 - Quality Control and Assurance Tests (including field cohesion and vane shear tests)
 - Quality Control Guidelines (including materials acceptance tests and mixture design verification)
 - A Checklist
 - Usage Guidelines.
- ISSA Inspector’s Manual—Available
- Caltrans Maintenance Technical Advisory Guide Final Draft—Available
- The ISSA Workshop Folder—Available

The guidelines and specifications will be a concise collection, presented in AASHTO format. This is one area of Phase III where the team can work at present. At the end of Phase II, the document will be appended with findings and recommendations relative to the new tests developed in Phase II.

Task 8—Workshop Training Program/Pre-Construction Module

The team agreed that work could commence in several chapters of the Reference Manual to be developed under this task. The Reference Manual will be a comprehensive, textbook-like document with background information, explanations, and pertinent information on the design and use of slurry systems.

|| A template for the Reference Manual has been produced and work has begun on the development.

Task 9—Pilot Projects/Procedure Validation

The team is working on the development of guidelines for selecting pilot projects to be used by State agencies. Currently, the proposed pilot project layout contains six different sections:

- A control section placed using the ISSA current procedure.
- A bare section (do nothing)
- Improved mix design (using the method developed in Phase II), Replicate 1
- Improved mix design (using the method developed in Phase II), Replicate 2
- Another bare section.
- Another contractor-based control (ISSA design).

Work on the guidance document started in September 2004 and will be completed during the next reporting period.

Task 10—Final Report

No Activity

NEXT MONTH'S WORK PLAN

The activities planned for next month are listed below.

- Coordinate with CALTRANS personnel on an as-needed basis.
- Continue with Phase II and Phase III activities.

PROBLEMS / RECOMMENDED SOLUTIONS

|| The process of acquiring the automated mixing test system has continued to be a problem. As noted above, the loan arrangements are being finalized and equipment delivery is expected by the end of September 2004.

ATTACHMENT A

Soundness of Aggregates by Use of Sodium Sulfate per ASTM C 88-99a

Solution: Sodium Sulfate. Solution was freshly prepared.

SAMPLE— LOPKE						
Sieve Size	As Received Grading of Original Sample, %	Weight of Fractions Before Test, g	% Passing Designated Sieve after Test	Weighted % Loss for Sample	Specifications	
					ISSA	Caltrans
12.5mm (1/2") to 9.5mm (3/8")	9.1	---	3.4 ^A	0.3		
9.5mm (3/8") to 4.75mm (#4)	23.0	100	3.4	0.8		
4.75mm (#4) to 2.36mm (#8)	25.9	100	2.9	0.8		
2.36mm (#8) to 1.18mm (#16)	12.7	100	3.4	0.4		
1.18mm (#16) to 600µm (#30)	7.0	100	3.3	0.2		
600µm (#30) to 300µm (#50)	4.7	100	3.0	0.1		
300µm (#50) to 150µm (#100)	3.9	---	---	---		
minus 150µm (#100)	13.7	---	---	---		
TOTAL:	100	---	RESULT:	2.6	15 Maximum	N/A

^A The percentage loss (3.4%) of the next smaller size is used as the percentage loss for this size, since this contains less than 10% coarser than the 3/8" sieve. See 11.1.3.1.

SAMPLE—TABLE MOUNTAIN-COARSE FRACTION ^B							
Sieve Size	As Received Grading of Original Sample, %	Grading of Original Sample, %	Weight of Fractions Before Test, g	% Passing Designated Sieve after Test	Weighted % Loss for Sample	Specifications	
						ISSA	Caltrans
12.5mm (1/2") to 9.5mm (3/8")	12.7	35.2	330	2.6	0.9		
9.5mm (3/8") to 4.75mm (#4)	23.4	64.8	300	2.5	1.6		
TOTAL:	---	100	---	RESULT:	2.5	15 Maximum	N/A

SAMPLE—TABLE MOUNTAIN-FINE FRACTION ^B							
Sieve Size	As Received Grading of Original Sample, %	Grading of Original Sample, %	Weight of Fractions Before Test, g	% Passing Designated Sieve after Test	Weighted % Loss for Sample	Specifications	
						ISSA	Caltrans
4.75mm (#4) to 2.36mm (#8)	23.0	36.0	100	3.7	1.3		
2.36mm (#8) to 1.18mm (#16)	13.8	21.6	100	3.1	0.7		
1.18mm (#16) to 600µm (#30)	9.8	15.3	100	1.6	0.2		
600µm (#30) to 300µm (# 50)	5.6	8.8	100	2.4	0.2		
300µm (#50) to 150µm (#100)	4.3	6.7	---	---	---		
minus 150µm (#100)	7.4	11.6	---	---	---		
TOTAL	TOTAL	---	---	RESULT:	2.4	15 Maximum	N/A

^B When an aggregate to be tested contains appreciable amounts of both fine & coarse material, having a grading with more than 10 weight % coarser than the 9.5mm (3/8") sieve and, also, more than 10 weight % finer than the 4.75mm (#4) sieve, test separate samples of the minus #4 fraction in accordance with the procedures for fine aggregate and coarse aggregate, respectively. Report the results separately for the fine aggregate fraction and the coarse aggregate fraction, giving the percentages of the coarse- and fine-size fractions in the initial grading. See 6.4